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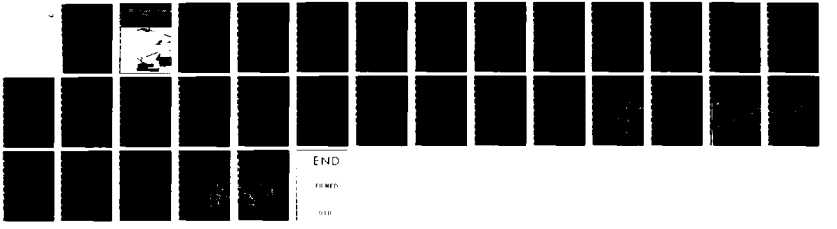

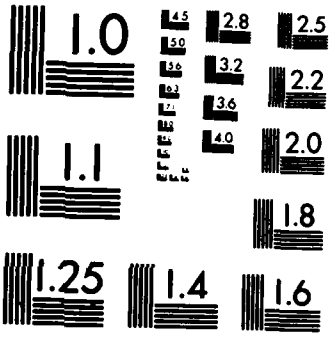

US Army Corps
of Engineers
New England Division

Drought Contingency Plan

November 1983

East Brimfield Lake, Sturbridge, Massachusetts

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

East Brimfield Lake can provide up to approximately 3,220 acre-feet (one billion gallons) of resevoir water storage for drought emergency purposes. The water would be suitable for public water supply after standard treatment methods.

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THAMES RIVER BASIN
QUINEBAUG RIVER WATERSHED

DROUGHT CONTINGENCY PLAN
EAST BRIMFIELD LAKE
STURBRIDGE, MASSACHUSETTS

NOVEMBER 1983

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

DROUGHT CONTINGENCY PLAN
EAST BRIMFIELD DAM

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DROUGHT CONTINGENCY PLAN
EAST BRIMFIELD LAKE

1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency plan of operation for East Brimfield Lake that would be responsive to public needs during drought periods and identify possible modifications to project regulation within current administrative and legislative constraints. This evaluation was based on preliminary studies utilizing readily available information. The scope of this drought contingency plan includes a description of existing water supply conditions, the possibility of reallocation of reservoir storage within specified limits, water quality evaluation, discussion of impacts on other project purposes, effects on the environment, and summary and conclusions.

2. AUTHORIZATION

The authority for the preparation of drought contingency plans is contained in ER 1110-2-1941 which provides that water control managers will continually review, and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basinwide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION

East Brimfield Lake was authorized by the Flood Control Act of 18 August 1941 (Public Law 228, 77th Congress). In addition, Section 4 of the Flood Control Act of 22 December 1944 (Public Law 534, 78th Congress) authorized recreational use of the reservoir area.

4. PROJECT DESCRIPTION

East Brimfield Lake, completed in 1960, is located on the Quinebaug River in the town of Sturbridge, Massachusetts. A map of the Thames River Basin is shown on plate 1.

The lake contains storage for conservation and flood control. The conservation pool which includes permanent storage, at elevation 632 NGVD (13-foot stage), contains 2,320 acre-feet (756 million gallons) equal to 0.65 inch of runoff. The flood control storage contains 29,900

acre-feet (9.7 billion gallons) equivalent to 8.3 inches of runoff from the 67.5 square mile drainage area. An area capacity table is shown on plate 2, and a summary of pertinent data at East Brimfield Lake is contained on plate 3.

Principal components of the project consist of a rolled earthfill and rock-faced dam, outlet works, and concrete spillway. The outlet works include a 19'-6" diameter horseshoe-shaped conduit approximately 210 feet long, and an intake with stoplog facilities for maintenance and emergency use in lieu of emergency gates. Two 6'-3" wide by 11' high sluice gates, electrically operated, with inverts at elevation 619 feet NGVD, control the flow through the dam.

In the upstream wall of the concrete box weir, located just upstream of the two gates, are two 24-inch square gates from which releases can be made from the 1,190 acre-foot (388 million gallons) conservation pool reserved for American Optical Company, a private concern located in Southbridge.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. A permanent pool approximately 13 feet deep is maintained by a concrete box weir and stoplog structure, located upstream from both gates. The gate setting, 1'-1', restricts discharges so that significant reservoir releases will not occur during unexpected events. If the pool stage drops below the weir during periods of low flow, releases may be made through two 24-inch square gates in the concrete weir.

b. Flood Periods. The East Brimfield project is operated in concert with other projects in the basin to reduce downstream flooding in the Quinebaug River. Operations for floods may be considered in three phases: phase I - appraisal of storm and river conditions during the development of a flood, phase II - flow regulation and storage of flood runoff at the reservoir and phase III - emptying the reservoir during recession of the flood. The regulation procedures are detailed in the Master Water Control Manual for the Thames River Basin.

c. Regulating Constraints

(1) Minimum Releases. A minimum release of about 15 cubic feet per second (cfs) or about 10 million gallons per day (mgd) is maintained during periods of flood regulation in order to sustain downstream fish life.

(2) Maximum Releases. The maximum non-damaging discharge capacity of the channel immediately downstream from East Brimfield Lake is about 900 cfs. Releases at or near this rate can be expected whenever reservoir inflows exceed this value, and meteorological and hydrologic conditions permit.

6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 31 New England Division flood control dams, and continually monitors rainfall, snowcover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corps Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with the respective Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. The area of concern is the south-central portion of Massachusetts, including portions of Worcester, Hampden, and Middlesex counties. Table 1 contains information about public water suppliers in the area, based on information provided by the Massachusetts Department of Environmental Management. Of the 36 communities in the study area, 31 are served by public systems. No data is available for those communities dependent on private individual supplies.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of East Brimfield Lake which could benefit from storage at the project, and to present the data in a manner portraying existing water supply conditions. Projections of future demands were not

TABLE 1

MAJOR WATER SUPPLIERS - SOUTH CENTRAL MASSACHUSETTS

Company or Agency	Town Served	Est. Population Served -1980	Source of Supply (SW or GW)	1980 Demands Avg. Day (MGD)	1980 Demands Max. Day (MGD)	Safe Yield (MGD)	Comments
Elm Hill Water District	Auburn	600					Supplied by Worcester(SW/GW)
Auburn Water District		9,501	GW	1.07	1.80	2.5	6 wells
Woodland Water District		540		0.027	0.041		Supplied by Worcester(SW/GW)
Blackstone Water Dept.	Blackstone	6,158	GW	0.37	0.63	0.78	2 Wells, 1 standby
	Brimfield		No Public Water Supply				
Brookfield Water Dept.	Brookfield	1,400	GW	0.078	0.117	0.40	3 Wells
	Charlton		No Public Water Supply				
Douglas Water Dept.	Douglas	2,611	GW	0.18	0.46	0.50	1 wellfield, 1 well
Dudley Water Dept.	Dudley	5,840	GW	1.2	1.81	1.0	1 wellfield, 1 well
East Brookfield Water Dept.	E. Brookfield	1,200	GW	0.12	0.292	0.9	1 well
Mass. American Water Co.	Grafton	5,332	GW	0.64	1.02	2.0	4 wells
South Grafton Water Dist.		2,810	GW	0.18	0.24	0.55	2 wells
	Holland		No Public Water Supply				
Hopedale Water District	Hopedale	2,226	GW	0.38	0.42	0.42	wellfield
						0.10	Milford Water Co.(SW/GW)
Hopkinton Water Dept.	Hopkinton	5,700	GW	0.571	0.837	1.11	3 wells
Leicester Water Supply Dist.	Leicester	2,700	GW	0.185	0.333	0.402	5 wells
Hillcrest Water Dist.		350	GW	0.154	0.175	0.236	3 wells
Cherry Valley & Rochdale W.D.		4,400	SW	0.32	0.70	0.375	Henshaw Pond
Milford Water Co.	Mendon	450	SW/GW				Included in Milford Syst.
Milford Water Co.	Milford	27,607	SW/GW	2.54	3.81	3.00	1.40 SW - Echo Lake 1.60 GW - wells Includes Mendon - 450 served Hopedale - 1667 served
Mass. American Water Co.	Milbury	5,366	GW	1.16	1.62	3.11	4 wells
Oakwood Heights Water Dist.		200		0.0074	0.011		Mass. American Water Co.
Maple Hillside Water Dist.		311		0.018	0.028		Mass. American Water Co.
	Millville		No Public Water Supply				

TABLE 1 (Cont'd)
MAJOR WATER SUPPLIERS - SOUTH CENTRAL MASSACHUSETTS

Company or Agency	Town Served	Est.Population Served - 198	Source of Supply (SW or GW)	1980 Demands Avg.Day (MGD)	1980 Demands Max. Day (MGD)	Safe Yield (MGD)	Comments
Monson Water Dept.	Monson	5,000	GW	0.95	1.70	1.73	2 wells, 1 standby
North Brookfield Water Dept.	N. Brookfield	3,600	SW	0.47	1.13	2.50	North Pond
Whitinsville Water Co.	Northbridge	10,340	GW	1.14	1.65	2.55	2 wellfields, 1 emergency
Oxford Water Co.	Oxford	6,070	GW	0.702	1.163	2.0	3 wells
Palmer Fire District	Palmer	5,300	SW/GW	0.62	1.00	0.90	0.65 - 2 wells, 0.25 - Graves Brk. Res.
Bondsville Fire & Water Dist.		2,516	GW	0.274	0.46	0.50	3 wells
Three Rivers Fire Dist.		3,377	GW	0.32	0.52	0.58	2 wells
Thorndike Fire & Water Dist.		1,316		0.144	0.25		From Bondsville supply
Shrewsbury Water Dept.	Shrewsbury	20,407	GW	2.56	4.44	4.18	2 wells, Worcester system
Southbridge Water Supply Co.	Southbridge	16,665	SW	1.71	2.56	2.95	4 reservoirs
Spencer Water Dept.	Spencer	5,000	SW/GW	0.37	0.55	1.30	1.0 - 1 well, 0.30 - Shaw Pond
Sturbridge Water Dept.	Sturbridge	3,884	GW	0.674	1.21	1.22	2 wells
Manchaug Water Dist.	Sutton	850	GW	0.016	0.024	0.045	3 wells
Wilkinsonville Water Dist.		400	GW	0.10	0.15	0.282	1 well
Upton Water Dept.	Upton	2,215	GW	0.23	0.38	0.69	1 well, 1 wellfield
Uxbridge Water Dept.	Uxbridge	5,600	GW	0.67	0.97	2.1	3 wells
	Wales		No Public Water Supply				
Ware Water Dept.	Ware	7,200	GW	0.92	1.12	1.58	4 wells
West Warren Water Dist.	Warren	1,078	GW	0.3	0.6	0.60	1 well, 1 standby
Warren Water Dist.		2,644	GW	0.19	0.30	0.35	5 wells
Webster Water Dept.	Webster	14,200	GW	1.29	1.94	3.50	2 wells & wellfield
W. Brookfield Water Dept.	W. Brookfield	2,200	GW	0.25	0.52	0.58	2 wells
Westborough Water Dept.	Westborough	13,346	SW/GW	2.02	2.5	2.78	0.75 - Westborough Res. 2.03 - 5 wells
Worcester DPW	Worcester	161,799	SW/GW	25.67	35.90	29.0	26.80 - reservoir system 2.20 - wells (2)

Table 2
Population Projections - South Central Massachusetts

Town	Actual 1980	1985	1990	1995	2000	Percent Change 1990-2000
Auburn	14,845	15,050	15,250	15,475	[illegible]	[illegible]
Blackstone	6,570	6,725	6,825	6,925	[illegible]	[illegible]
Brimfield	2,318	2,508	2,681	2,794	[illegible]	[illegible]
Brookfield	2,397	2,575	2,625	2,675	[illegible]	[illegible]
Charlton	6,719	7,050	7,500	7,675	[illegible]	[illegible]
Douglas	3,730	3,850	3,925	4,100	4,200	12.6
Dudley	8,717	9,050	9,200	9,400	9,725	11.6
East Brookfield	1,955	2,050	2,150	2,200	2,300	[illegible]
Grafton	11,238	11,450	11,750	11,975	12,175	[illegible]
Holland	1,589	1,902	2,193	2,430	2,578	62.2
Hopedale	3,905	4,000	4,125	4,150	4,200	7.6
Hopkinton	7,114	8,300	9,400	9,700	10,000	40.6
Leicester	9,446	9,600	9,700	9,950	10,075	6.7
Mendon	3,108	3,350	3,450	3,625	3,725	19.9
Milford	23,390	24,700	26,000	26,300	26,600	13.7
Millbury	11,808	12,175	12,450	12,725	12,925	9.5
Millville	1,693	1,750	1,800	1,825	1,875	10.8
Monson	7,315	7,688	8,026	8,427	8,823	20.6
North Brookfield	4,150	4,225	4,300	4,325	4,375	5.4
Northbridge	12,246	12,450	12,650	12,950	13,225	8.0
Oxford	11,680	12,100	12,350	12,725	12,925	10.7
Palmer	11,389	11,731	12,048	12,265	12,424	9.1
Shrewsbury	22,674	23,650	24,225	24,925	25,400	12.0
Southbridge	16,665	16,775	16,875	16,975	17,125	2.8
Spencer	10,774	11,200	11,600	12,025	12,225	13.5
Sturbridge	5,976	6,325	6,575	6,725	6,975	16.7
Sutton	5,855	6,350	6,725	6,950	7,225	23.4
Upton	3,886	4,125	4,225	4,425	4,525	16.4
Uxbridge	8,374	8,575	8,675	8,750	8,850	5.7
Wales	1,177	1,326	1,475	1,596	1,671	42.0
Ware	8,953	9,311	9,600	9,782	9,939	11.0
Warren	3,777	3,800	3,850	3,975	4,025	6.6
Webster	14,480	14,625	14,875	15,100	15,200	5.0
West Brookfield	3,026	3,100	3,150	3,175	3,250	7.4
Westborough	13,619	14,275	14,825	15,625	16,050	17.9
Worcester	161,799	161,800	161,800	161,800	161,800	0.0
TOTAL	448,357	459,516	468,873	476,444	482,910	7.7

developed because this study addresses only modifications in the operational procedure at East Brimfield Lake in order to provide storage for water supply purposes when drought conditions exist, and not to meet normal water supply demands at some future date.

c. South-central Massachusetts Water Suppliers. Information pertaining to water suppliers is given in table 1. The data for each water supplier includes: community served, estimated population served by the system, source of supply (ground or surface water), average day and maximum day demands for 1980, estimated safe yield of the source, and any further information available on the source of supply. An analysis of the adequacy of existing sources during drought conditions has not been performed. The information has been accumulated to present a summary of the existing water supply conditions for the south-central Massachusetts area.

d. Population Projections. Population projections for communities in south-central Massachusetts are given in table 2 to show population trends for each community potentially affected by a prolonged dry period. The projections were developed by the Massachusetts Office of State Planning for the "208" areawide Wastewater Management Program, and updated in 1981. This information indicates areas of potential future growth in the south-central Massachusetts area.

8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local communities in need. In addition, guidance contained in ER 1110-2-1941 directs field offices to determine the short-term water supply capability of existing Corps reservoirs that would be functional under existing authorities. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purposes.

b. Drought Contingency Storage. It has been determined that a portion of the existing flood control storage at East Brimfield Lake could be utilized for emergency drought contingency storage without

having an adverse impact on the project's flood control function. Storage could be made available to a pool elevation of about 634 feet NGVD (15-foot stage). This represents a total volume of about 3,220 acre-feet, equivalent to 1 billion gallons or about 11 percent of the total reservoir storage. This volume is comprised of 1,130 acre-feet of permanent storage, 1,190 acre-feet of conservation storage, and 900 acre-feet of flood control storage. The 900 acre-feet represents an infringement of about 0.25 inch of runoff on the flood control storage.

The American Optical Company is a riparian user of Quinebaug River waters just downstream of Westville Lake in Southbridge, and that company owns 1,190 acre-feet of storage between elevation 628 and 632 in the East Brimfield Reservoir. The company uses the storage to augment riverflows for industrial use during the period of 30 June to 31 December. Therefore, the total volume of 3,220 acre-feet could not be made available at East Brimfield during the summer season. The opportune time to fill the drought contingency storage at East Brimfield, in anticipation of a possible later drought condition, would be during the late spring runoff period.

An all-season low flow duration analysis using flow records for the gaging station on the Quinebaug River at East Brimfield was developed by correlating the short term record at East Brimfield with the longer term record at the Quinebaug River at Westville Lake. Based on this analysis, it was determined that during a 10-year frequency drought the volume of runoff could: a) fill the reservoir from elevation 632 to 634 feet NGVD in a 32-day period provided no releases were made from the dam, or b) fill the reservoir to elevation 634 in a 62-day period if a continuous release of about 6.8 cfs or 4.4 mgd (0.10 cfs/sq. mi.) were maintained. However, the reservoir could be filled to elevation 634 in about a 2-week period in May while continuously releasing about 10 cfs or 6.4 mgd. The water stored could be drawn directly from the reservoir or released downstream for municipal supply with proper treatment. Drought contingency storage versus flow duration at East Brimfield Lake is shown graphically on plate 4.

c. Effects of Regulated Flows. As discussed, in specific reference to American Optical Company, the curtailment of flows from East Brimfield Lake during the drought emergency could adversely impact

the flowage rights of downstream riparian users. At this time, however, it is not possible to review all of the various drought emergency situations that could occur, nor is it within the scope of this report to identify all those with water rights. It is important to note that when a specific drought emergency situation does occur, the legal implications would have to be weighed.

9. WATER QUALITY EVALUATION

a. Water Quality Classification. The entire length of the Quinebaug River in Massachusetts is rated class B by the Massachusetts Division of Water Pollution Control. Class B waters are designated for the protection and propagation of fish, other aquatic life and wildlife; and for primary and secondary contact recreation. Public water supply after treatment is not one of the uses given in Massachusetts Water Quality Standards for class B waters. However, a water which meets class B standards could be made potable by standard treatment processes.

The Quinebaug River within the boundaries of the East Brimfield Lake project has been further designated as a cold water fishery. Technical requirements for class B cold water fisheries include a minimum dissolved oxygen concentration (DO) of 6 mg/l, a maximum temperature of 68°F, pH in the range of 6.5-8.0 standard units and fecal coliform bacteria not to exceed a log mean of 200 per 100 ml for a set of samples, nor shall more than 10 percent of the total samples exceed 400 per 100 ml during any monthly sampling period; and the waters shall be free from pollutants in concentrations that exceed the most sensitive receiving water use.

b. Existing Water Quality. East Brimfield Lake has generally good water quality but does not fully meet the requirements of its Massachusetts class B designation. Principal concerns are low pH levels, high color levels, occasional low DO concentrations and high coliform counts, warm water temperatures, and elevated nutrient levels. The low pH and high color levels are due to natural conditions in the watershed; elevated nutrient levels, high coliform counts, and low DO levels are due to a combination of natural conditions and runoff from developed areas. The warm temperatures in the lake are due to solar heating enhanced by its shallowness and its long detention time. A weir controlled outlet causes the release of the warm surface waters thus somewhat

reducing the temperature of the discharge. These conditions cause the temperatures in the lake and the discharge frequency to exceed the desirable limits for a cold water fishery.

Iron and manganese levels are high at this project. This is not a violation of class B standards but means that treatment would be required to remove these metals prior to the water's use for potable supply.

Excessive aquatic weed growth is a serious problem at East Brimfield Lake, adversely affecting swimming and boating. A combination of factors including shallow pool depth, occasional high nutrient inflows, high nutrient levels in the lake-bottom soils, and long hydraulic detention time contribute to this problem.

Several methods of weed control have been tried at the East Brimfield project. During the summers of 1966 and 1967, the pool elevation was raised two feet (to elevation 634.0 feet NGVD) for the purpose of providing more suitable depth for swimming at the beach and also to submerge aquatic weeds for improved boating. From December 1970 through February 1971, the pool was lowered to stage 6.5 feet (625.5 feet NGVD) exposing about 140 acres of shoreline with the hope of freezing the weeds. In October 1972, the lake was treated with the herbicide Silvex. These operations have achieved partial success in controlling weeds.

c. Water Quality Requirements for Drought Storage. There are two requirements to be met. The waters must meet state standards for surface waters and must be of a quality suitable for the user. A water which meets class B standard could be made usable for public water supply with standard treatment processes. The water quality required for industrial water supply depends on the industrial process involved. The stored water at East Brimfield Lake would always be of a quality suitable for fire-fighting.

d. Effects of Drought Storage. Increasing the size of the permanent pool at East Brimfield Lake for drought storage will cause some minor increases in existing water quality problems but may temporarily alleviate some of the aquatic weed problem. The net effect would be that the suitability of the water in the lake for water supply would not change.

Raising the pool from stage 13 feet to stage 15 feet will inundate an additional 220 acres of land. The decay of organic material on this land would cause anaerobic conditions in parts of the lake which would, in turn, cause minor increases in dissolved iron and manganese levels and soluble nutrients levels.

The increase in the lake depth will submerge the existing aquatic weeds, killing some of them. While these weeds will re-establish themselves in the newly inundated areas, this will take some time and the net effect will be a temporary alleviation of the problem.

The increased hydraulic residence time in the lake and the change from a weir discharge to a gate discharge (in order to maintain a pool level higher than the weir crest) will tend to increase lake surface temperatures. However, the lower level gate discharge means that discharge temperatures will probably not differ much from existing temperatures.

e. Water Quality Conclusions. If the pool at East Brimfield Lake is raised to a stage of 15 feet to provide drought storage, the quality of the water would be suitable for public supply after standard treatment, or for some industrial water supply uses, and fire-fighting without treatment. If herbicides have been applied to the lake within the past year, additional expensive treatment with activated carbon may be required to alleviate public concerns about a possible health threat, although no real threat may exist.

10. DISCUSSION OF IMPACTS

a. General. Any action resulting in a temporary change of a reservoir's storage volume will have impacts on other project purposes which must be evaluated before a storage reallocation plan can be implemented. An evaluation has been made of the impacts resulting from drought contingency storage on the flood control purpose of this project. Effects on recreation, sedimentation and the aquatic and terrestrial environments as well as the historic and archaeological resources have also been addressed.

b. Flood Control. A review of the regulation procedures at East Brimfield Lake was undertaken to determine the volume of water that could be made available for drought contingency purposes.

The water would be temporarily stored by utilizing existing flood control storage. It is recognized that major floods occur in every season of the year, thus any use of flood control storage would be continually monitored to insure there would be no adverse impacts on downstream flood protection.

At East Brimfield Lake, the maximum pool elevation for drought contingency storage has been estimated to be elevation 634 feet, representing an infringement on the flood control storage of about 0.25 inches of runoff from the upstream 67.5 square mile drainage area.

Based on a 10-year event, the anticipated rate of pool level rise would be about 0.03 feet per day over a 62-day period beginning in May. This condition assumes a flow of about 6.8 cfs (0.1 csm) would be released downstream for the duration of the drought. The storage may be held for a period of one month or longer at the 634-foot level before withdrawal.

c. Recreation. The recreation areas in East Brimfield Lake will be largely unaffected by raising the pool level from stage 13 to stage 15. Approximately one-half of the state-managed beach at the Streeter Point recreation area will be above the waterline at stage 14. Both boat ramps will be unaffected. Holland Pond (elevation 635) upstream of East Brimfield Lake will not be affected by the proposed drought storage.

d. Project Operations. The additional two feet of storage will be accomplished using stoplogs in the box weir. Minimum releases can be accomplished by using the 24-inch gates in the upstream wall of the weir. A minimum amount of labor will be required to store the additional two feet of water.

e. Effect on the Aquatic Ecosystem. The aquatic environment of the project area is located along the Quinebaug River in the Thames River basin. East Brimfield Lake and its tributaries have a class B water quality designation according to the Massachusetts Division of

Water Pollution Control and was determined to be mesotrophic. East Brimfield Lake (Long Pond and the conservation pools) supports a successful warm water fishery with an excellent bass population, but is unsuitable as habitat for indigenous trout due to the warm water lake type conditions. Fisheries management is conducted by the Massachusetts Division of Fisheries and Wildlife which stocks rainbow trout in tributary streams, usually in the 12-inch size class. In the past, northern pike were stocked in the reservoir when they were available. However, no pike reproduction has been observed and the Division now stocks tiger muskies. The Quinebaug River flows between Holland Pond and the conservation pool and is generally considered to be a slow moving river.

Fish population sampling has found twelve species in the lake including largemouth bass, bluegill, brown and yellow bullhead, brown and eastern brook trout, tiger muskie, white and yellow perch, chain pickerel, pumpkin seed, and white sucker.

Holland Pond provides a well balanced fish community with the greatest fish diversity and standing crop. Both Long Pond and East Brimfield Lake have less diversity and standing crop than Holland Pond. Long Pond, while having similar species diversity as the reservoir conservation pool, has about twice the standing fish crop, primarily in two species; bluegill and largemouth bass. The low standing crop in East Brimfield Lake may be related to the extensive aquatic macrophyte community.

The major aquatic problem at the East Brimfield project is the substantial amount of submerged and emergent aquatic macrophyte growth. There is the potential that without action to control it, its growth may affect the lake's recreational value, interfere with the fishery and accelerate the eutrophication process with further successional changes.

Wetlands cover approximately 740 acres of the project area when a 632-foot impoundment elevation is maintained. This includes approximately 360 acres of marsh and about 380 acres of hardwood swamp. These areas are principally around the Quinebaug River between Holland Pond and the East Brimfield dam. Plate 5 shows a map of of the reservoir area. A majority of marsh areas lie outside of the

impoundment area along the Mill Brook before it converges with the Quinebaug River. A two-foot rise in the reservoir's level would inundate approximately another 200 acres, nearly all of which would likely be wetlands. Although the actual size of the areas would need to be determined, as well as their habitat values, approximately equal areas of marsh and hardwood swamp would be affected, all of which would be along the Quinebaug River between the dam and Holland Pond. The entire river between the pond and the dam is a slow moving river that meanders between marsh areas and hardwood swamps and principally supports a warm water fishery for approximately two miles. With the drought contingency pool operating at elevation 634, a 4,000 foot section of the river, between the pond and the reservoir would remain unaffected by the backwaters of the pool. Wood duck boxes have been placed principally along this section of the river.

An increase in the impoundment for the proposed drought contingency storage would temporarily raise the water level by two feet through the storage period. Generally, temporary pooling of this extra storage for a season would not have any substantial effect on the aquatic ecosystem. No substantial fishery effects are expected. The increased storage should not impact the reproduction of most warm water species (generally occurring during spring and early summer) in the reservoir and the Quinebaug River. It actually may induce added population for the year class in which storage occurred. Should the wetlands in the project area become inundated during temporary storage, no long term effect is anticipated. The increased pool probably would not have any greater impact than which has occurred with past flood control operations. However, should the contingency storage be required for prolonged periods, continuous use or for repetitive frequency use, then the impacts on the existing wetlands, and the potential for creating new wetlands, would have to be assessed.

f. Effects on the Terrestrial Environment. Other than the stands of hardwood swamp, there are six principal forest types at East Brimfield. The two largest types include white pine/red oak/white ash and northern red oak/basswood/white ash. The second largest two groups are white pine and white pine/hemlock. The smallest two groups are northern red oak and aspen. Generally, these upland species are set back from the river by the marsh and hardwood swamps. These areas would not be affected by the increased pool elevation.

g. Effects on Wildlife. The aesthetic values of wildlife observation are the most important human values of wildlife management at East Brimfield. There is a wide diversity of habitats at East Brimfield with the wetland marsh, hardwood swamp, different forest types at successional stages, and open field areas to support wildlife. Observation of wildlife at the project area has indicated the presence of the following: red fox, raccoon, porcupine, woodchuck, snowshoe hare, cottontail rabbit, beavers, skunk, muskrat, gray squirrel and white tailed deer. A couple of the upland bird species include woodcock and ruffed grouse. Several species of ducks have been seen on the lake's waters including mallard, black ducks and wood ducks. Canadian geese and great blue herons have also been sighted. No rare and endangered species are known to exist at East Brimfield Lake.

Any effect on wildlife from raising the storage pool two feet would likely be the result of impacts that might occur to the wetlands. It is not anticipated that temporary storage would significantly affect wildlife habitat. Impacts to wetland, shallow areas, and the user species for prolonged inundation would have to be assessed further. No impact to deer population is expected since the forest and open field habitat would not be affected. They would not be impeded from access to the water's edge.

h. Historic and Archaeological Resources. Although there has been no systematic archaeological survey at East Brimfield Lake, numerous prehistoric sites have been identified within the project area with dates ranging from the early 17th century to possibly as far back as the Paleo-Indian Period (ca. 9000 B.C.). Of recorded sites, three may extend to elevations which would result in impacts upon them from a drought contingency pool at elevation 634 feet NGVD. The sites of at least one dairy farm, a gristmill, a sawmill, and a tool company would also be affected. These historic sites all date from prior to 1870, and possibly as early as the 18th century.

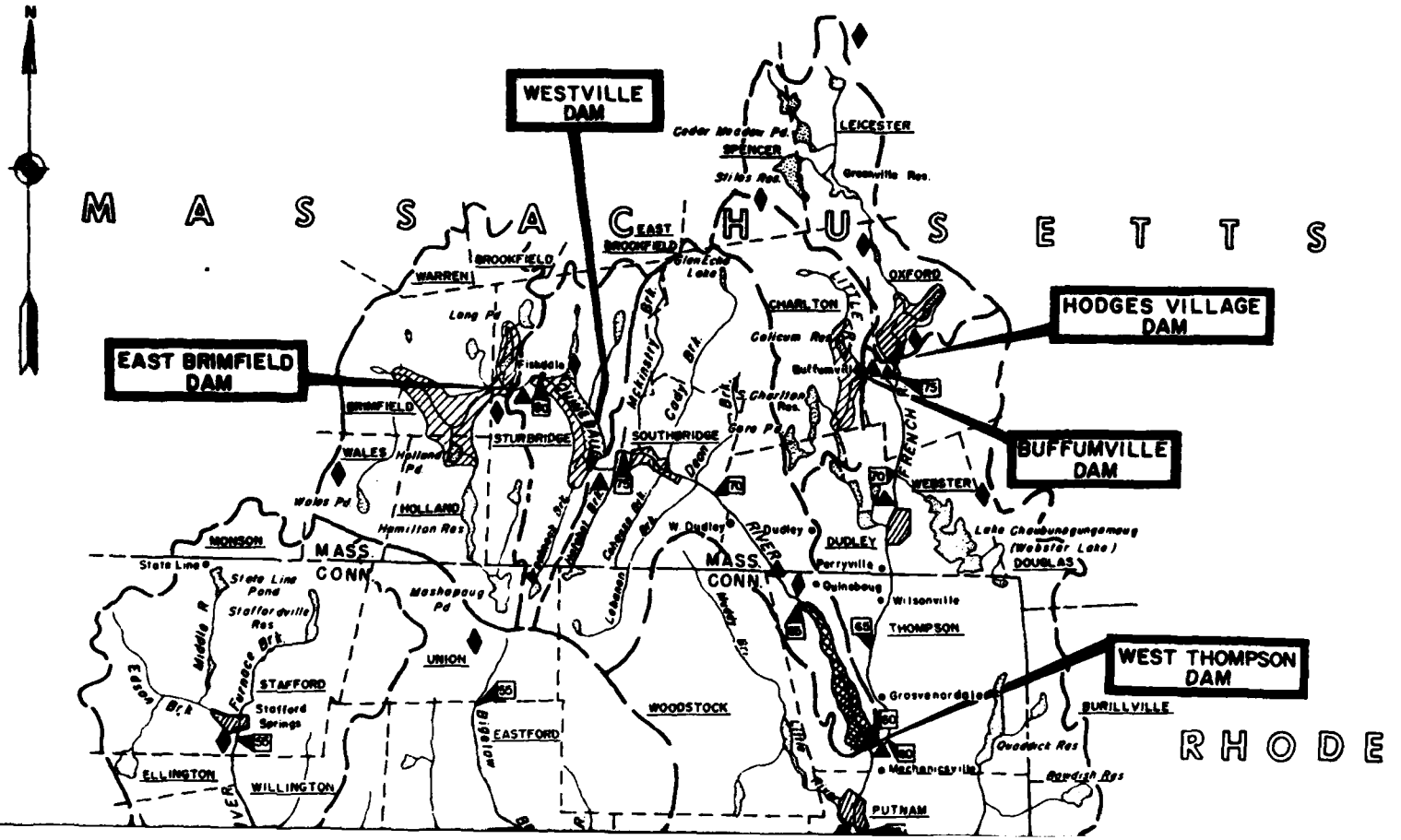
11. SUMMARY AND CONCLUSIONS

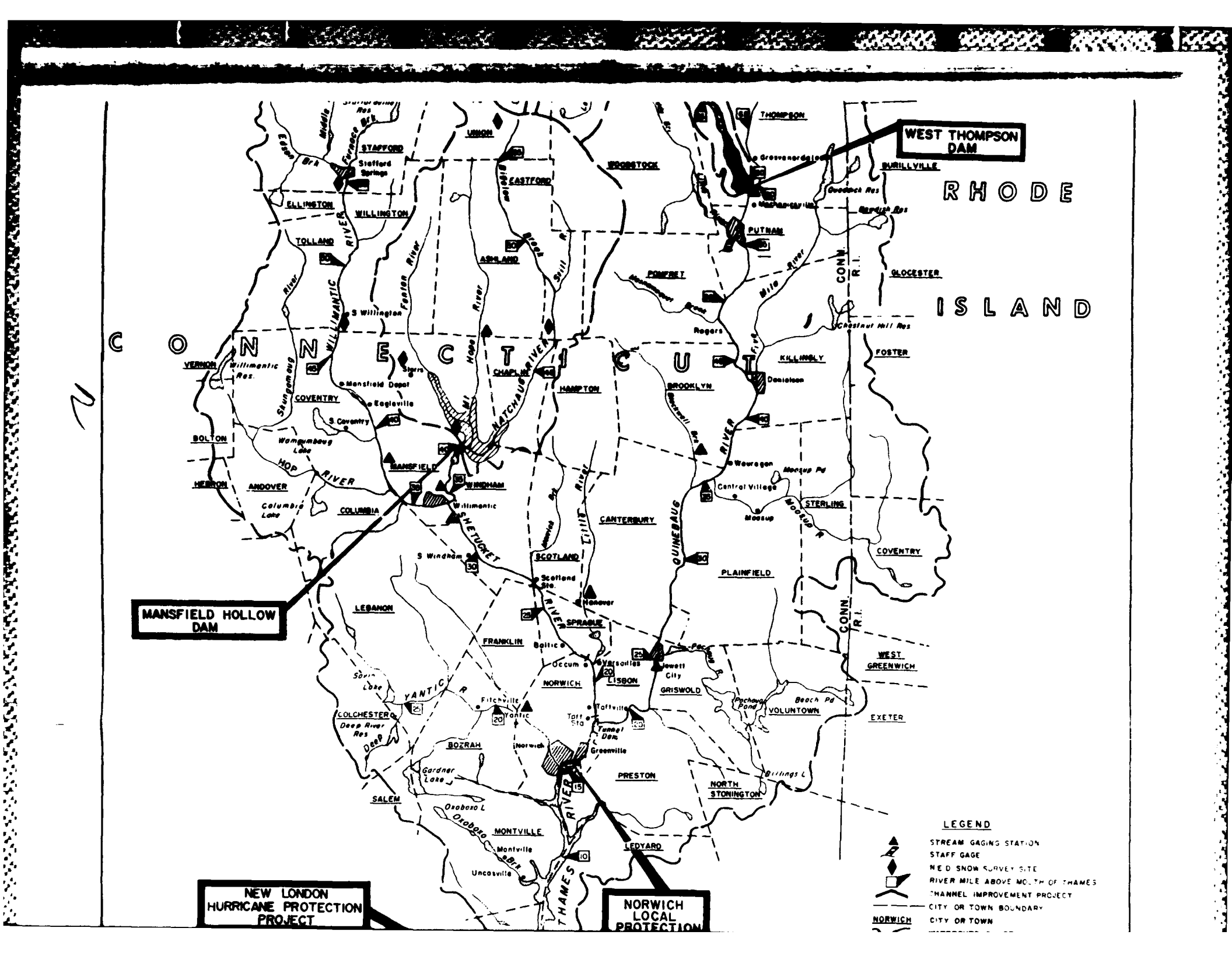
Hydrologic studies indicate it would be possible to provide up to approximately 3,220 acre-feet (one billion gallons) of reservoir storage for drought emergency purposes, without having a significant adverse impact on the overall effectiveness of East Brimfield Lake. An evaluation of the effects of drought contingency storage on various other project features, as well as on certain environmental aspects, has revealed no significant impacts.

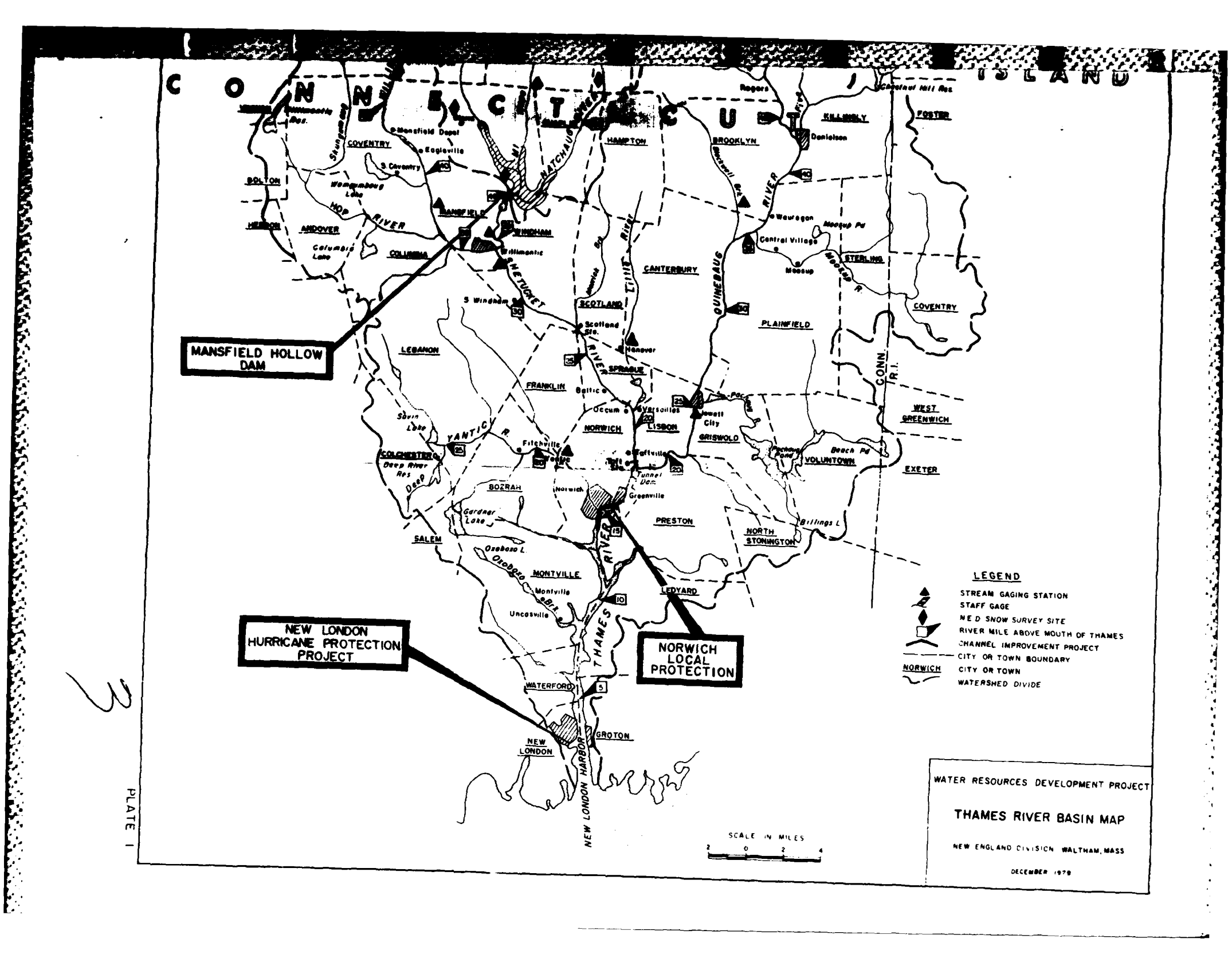
The water at East Brimfield Lake would be suitable for public water supply after standard treatment methods. However, if herbicides have been applied within the past year, additional expensive treatment might be required before the public would accept the water as safe even though no real threat from the herbicides may exist. The untreated stored water may be acceptable for some industrial water supply uses or related activities.

CORPS OF ENGINEERS

U.S. ARMY




WEST THOMPSON DAM
MANSFIELD HOLLOW DAM
NEW LONDON HURRICANE PROTECTION PROJECT
NORWICH LOCAL PROTECTION
RHODE ISLAND
CONNECTICUT
THOMPSON
UNION
STAFFORD
EASTFORD
ELLINGTON
WILLINGTON
TOLLAND
ASHFORD
PUTNAM
POMFRET
GLOCESTER
VERNON
COVENTRY
BOLTON
HEBRON
ANDOVER
COLUMBIA
MANSFIELD
WINDHAM
CHAPLIN
HAMPTON
BROOKLYN
KILLINGLY
FOSTER
CANTERBURY
SCOTLAND
PLAINFIELD
STERLING
LEBANON
FRANKLIN
SPRAGUE
NORWICH
LISBON
GRISWOLD
VOLUNTOWN
WEST GREENWICH
EXETER
COLCHESTER
BOZRAH
SALEM
PRESTON
NORTH STONINGTON
MONTVILLE
LEDYARD
Willimantic Res.
Mansfield Depot
Eagleville
S. Coventry
Wangumbaug Lake
Columbia Lake
S Windham
Willimantic
Scotland Sta
Hanover
Baltic
Occum
Versailles
Jewett City
Fitchville
Yantic
Taftville
Taft Sta
Tunnel Dam
Greenville
Norwich
Deep River Res
Gardner Lake
Oxoboxo L
Montville
Uncasville
Quaddick Res
Mashapaug Res
Chestnut Hill Res
Pachaug Pond
Beach Pd
Billings L
Moosup Pd
Central Village
Wauregan
Danielson
Rogers
S Willington
Stafford Springs
Moosup
LEGEND
STREAM GAGING STATION
STAFF GAGE
N E D SNOW SURVEY SITE
RIVER MILE ABOVE MOUTH OF THAMES
CHANNEL IMPROVEMENT PROJECT
CITY OR TOWN BOUNDARY
NORWICH CITY OR TOWN


MANSFIELD HOLLOW DAM
NEW LONDON HURRICANE PROTECTION PROJECT
NORWICH LOCAL PROTECTION
LEGEND
STREAM GAGING STATION
STAFF GAGE
N.E.D. SNOW SURVEY SITE
RIVER MILE ABOVE MOUTH OF THAMES
CHANNEL IMPROVEMENT PROJECT
CITY OR TOWN BOUNDARY
NORWICH CITY OR TOWN
WATERSHED DIVIDE
SCALE IN MILES
2 0 2 4
WATER RESOURCES DEVELOPMENT PROJECT
THAMES RIVER BASIN MAP
NEW ENGLAND DIVISION WALTHAM, MASS
DECEMBER 1979
PLATE I
CONNECTICUT
RHODE ISLAND
THAMES RIVER
NEW LONDON HARBOR
QUINEBAUG R.
SHETUCKET R.
YANTIC R.
NORWICH
NEW LONDON
GROTON
WATERFORD
MONTVILLE
LEDYARD
PRESTON
NORTH STONINGTON
GRISWOLD
VOLUNTOWN
PLAINFIELD
CANTERBURY
SCOTLAND
FRANKLIN
LEBANON
COLCHESTER
SALEM
BOZRAH
EXETER
WEST GREENWICH
COVENTRY
HAMPTON
BROOKLYN
KILLINGLY
POSTER
STERLING
WINDHAM
MANSFIELD
ANDOVER
BOLTON
COLUMBIA
LISBON
SPRAGUE
NORTH STONINGTON

EAST BRIMFIELD RESERVOIR
AREA AND CAPACITY
DRAINAGE AREA - 67.5 SQ. MI.

Elevation (msl)	Stage (feet)	Area (acres)	Capacity Acre-Feet	Capacity Inches
		Permanent Storage		
619	0	Sill of Flood Gates		
620.1	1.1	Sill of Weir Gates		
621	2	40	40	0.01
622	3	57	90	0.03
623	4	72	150	0.04
624	5	90	230	0.06
624	5	200	(Long Pond)	
625	6	210	430	0.12
626	7	225	650	0.18
627	8	240	880	0.24
628	9	260	1,130	0.31
		Conservation Storage		
628	9	260	0	0
629	10	280	270	0.07
630	11	295	550	0.15
631	12	310	860	0.24
632	13	360	1,190	0.33
		Flood Control Storage		
632	13	360	0	0
633	14	400	380	0.11
633	14	480	(Holland Pond)	
634	15	560	900	0.25
635	16	650	1,500	0.42
636	17	790	2,220	0.62
637	18	960	3,090	0.86
638	19	1,100	4,120	1.14
639	20	1,210	5,270	1.46
640	21	1,300	6,510	1.81
641	22	1,380	7,850	2.18
642	23	1,460	9,270	2.58
643	24	1,540	10,800	3.00
644	25	1,610	12,300	3.42
645	26	1,690	14,000	3.89
646	27	1,770	15,700	4.36
646	28	1,850	17,500	4.86
648	29	1,920	19,400	5.40
649	30	2,000	21,400	5.94
650	31	2,070	23,400	6.50
651	32	2,140	25,500	7.09
652	33	2,220	27,700	7.70
653	34	2,300	29,900	8.30

NOTES: Gate Sill Elevation = 619
Spillway Crest Elevation = 653
1" Runoff = 3,600 acre-feet

PLATE 2

PERTINENT DATA
EAST BRIMFIELD LAKE

LOCATION — Quinebaug River, Sturbridge, Massachusetts

DRAINAGE AREA — 67.5 square miles

STORAGE USES — Flood control, Recreation, Conservation

RESERVOIR STORAGE

	Elevation (ft msl)	Stage (feet)	Area (acres)	Capacity: Acre-Feet	Capacity: Inches on Drainage Area
Inlet Elevation	619.0	0.0	0	0	0.0
Permanent Pool	628.0	9.0	260	1,130	0.31 (net)
Conservation Pool	632.0	13.0	360	1,190	0.33 (net)
Spillway Crest	653.0	34.0	2,300	29,900	8.3
Maximum Surcharge	667.3	48.0	3,500	-	-
Top of Dam	672.2	53.2	4,000	-	-

EMBANKMENT FEATURES

Type	Rolled earth with rock slope protection
Length (ft)	520
Top Width (ft)	24
Top Elevation (ft msl)	672.2
Height (ft)	55
Volume (cy)	69,000

SPILLWAY

Location	Right (south) abutment
Type	Concrete ogee chute
Crest Length (ft)	75
Crest Elevation (ft msl)	653.0
Surcharge (ft)	14.3
Maximum Discharge Capacity (cfs)	15,520
Spillway Design Flood	
Peak Inflow (cfs)	73,900
Peak Outflow (cfs)	15,520

OUTLET WORKS

Type	Horseshoe conduit
Tunnel Diameter (ft)	10.5
Tunnel Length (ft)	210
Service Gate Type	Two, slide gate, screw lift, electrically operated
Service Gate Size (ft)	6.25 wide x 11.0 high
Emergency Gate Type	Stoplogs only
Downstream Channel Capacity	Non-growing season: 900+ Growing season: 750
Maximum Discharge Capacity with Pool at Spillway Crest Elevation (cfs)	Two gates, 3,300
Stilling Basin	None (outlet channel training dike)
Weir Gates	Two, 24" x 24", manually operated

CONSERVATION POOL

Length (ft)	10,570
Shoreline Length (ft)	45,910
Area (acres)	360

LAND ACQUISITION

	Elevation (ft msl)	Stage (feet)	Area (acres)
Fee Taking	644	25	2,070
Easement	656	37	647
Clearing	634	15	400

MAXIMUM POOL OF RECORD

Date	March 1968
Stage (ft)	23.8
Percent Full	35

UNIT RUNOFF

One Inch Runoff (acre-ft)	3,600

OPERATING TIME

Open/Close all Gates	1 ft/min. Manual operation: 61 turns/inch

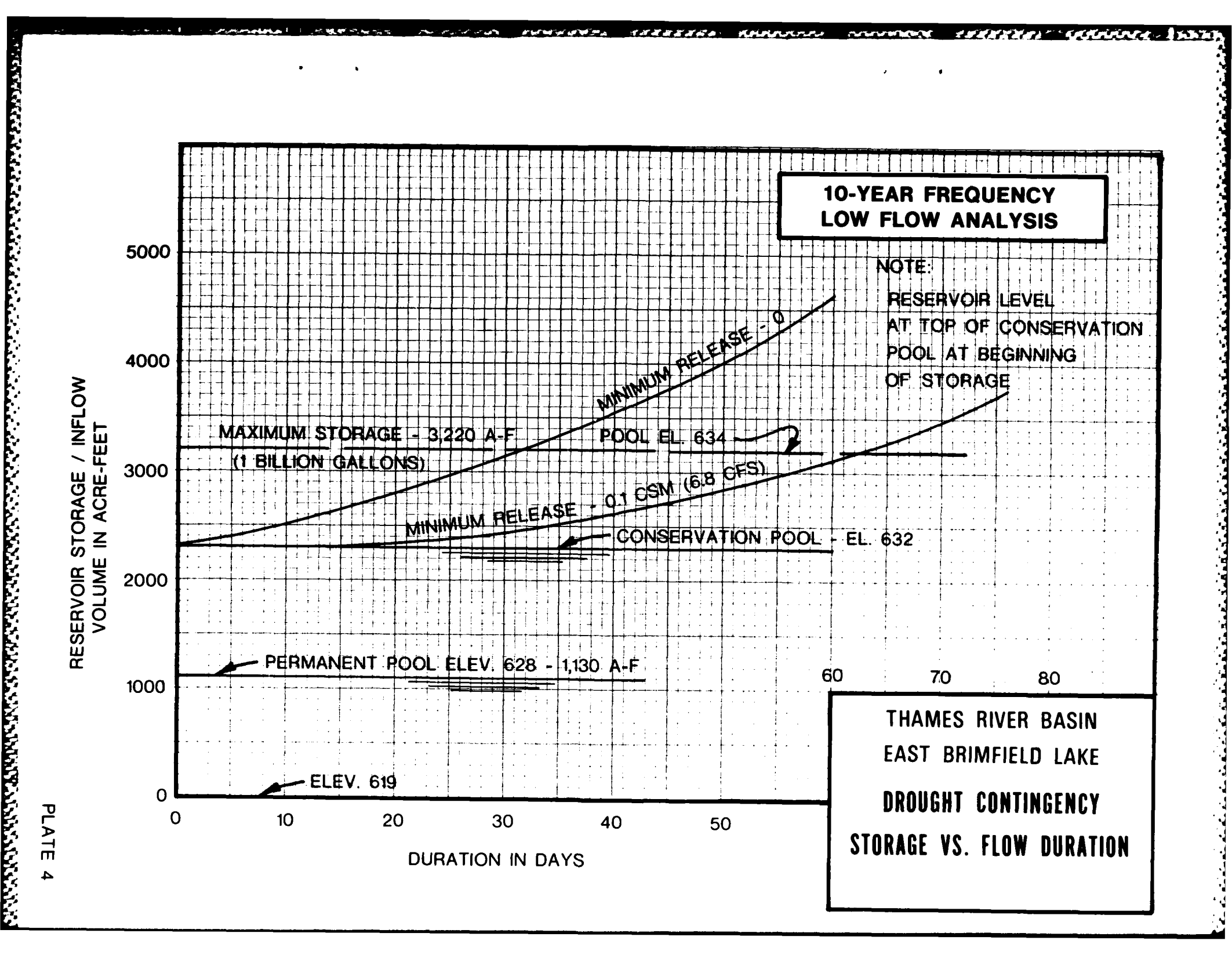
PROJECT COST

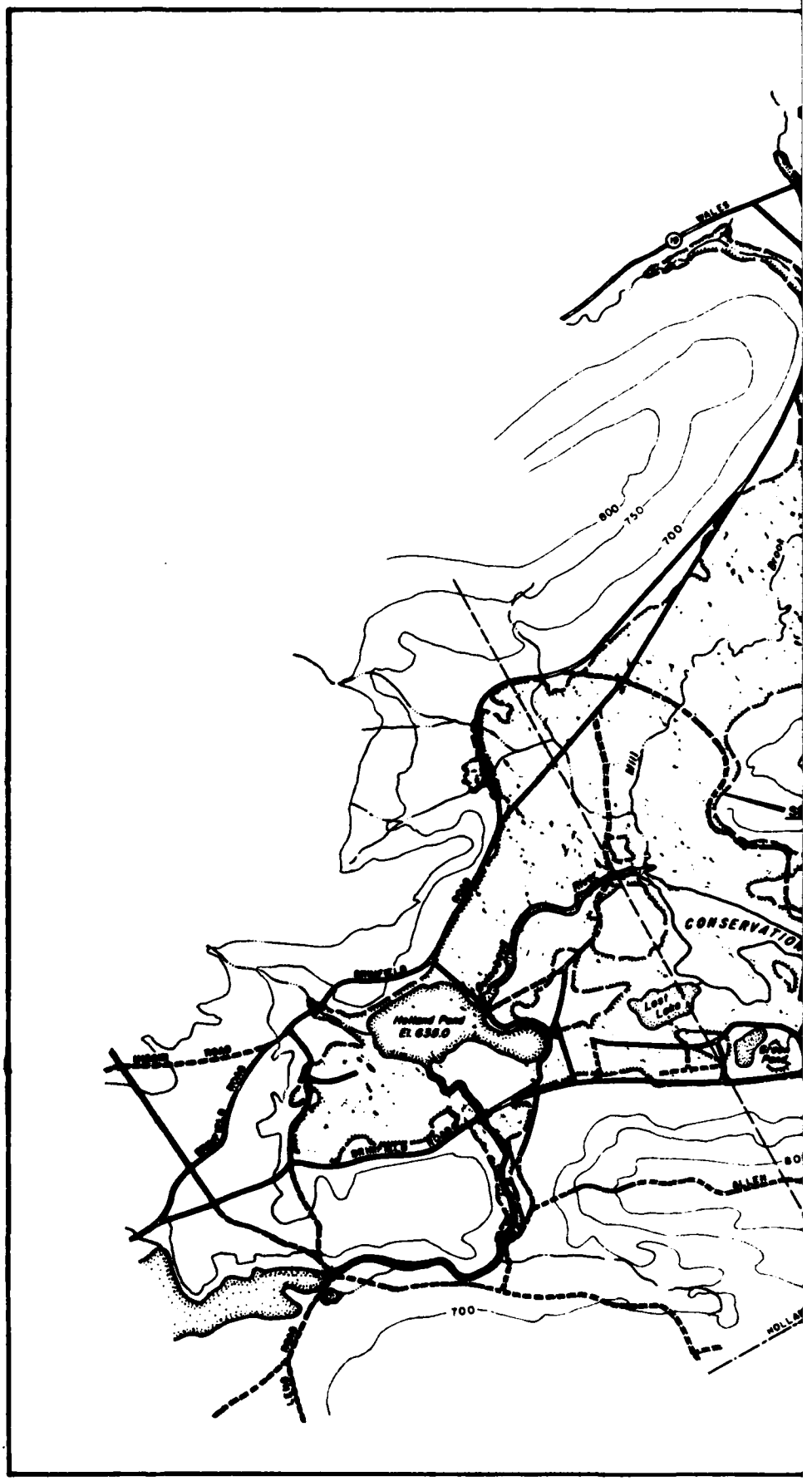
Through September 1977	$7,057,000

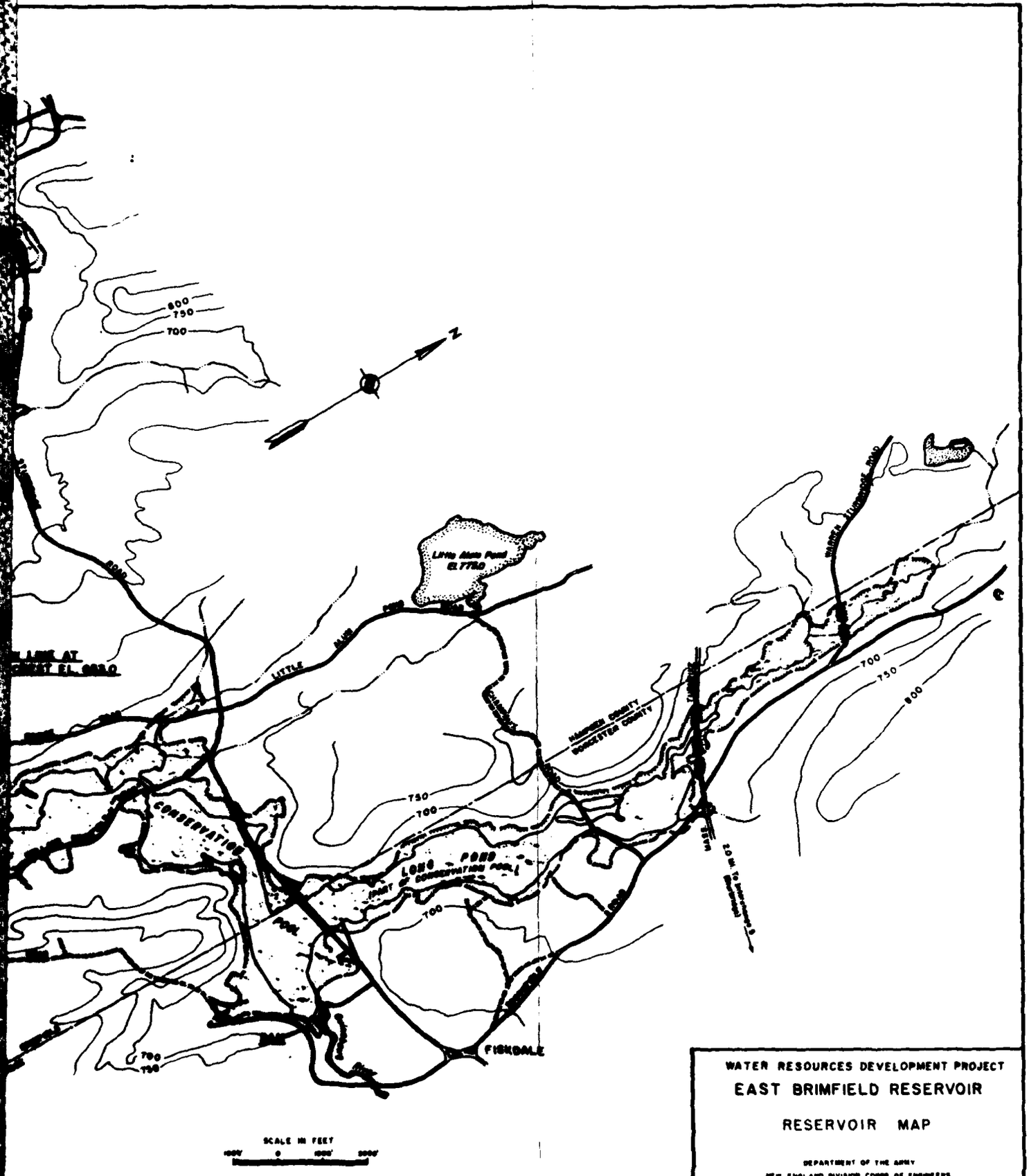
DATE OF COMPLETION — 1960

MAINTAINED BY — New England Division, Corps of Engineers
Recreation facilities are maintained by the Commonwealth of Massachusetts

PLATE 3


10-YEAR FREQUENCY
LOW FLOW ANALYSIS
NOTE:
RESERVOIR LEVEL
AT TOP OF CONSERVATION
POOL AT BEGINNING
OF STORAGE
MINIMUM RELEASE - 0
MAXIMUM STORAGE - 3,220 A-F
(1 BILLION GALLONS)
POOL EL. 634
MINIMUM RELEASE - 0.1 CSM (6.8 CFS)
CONSERVATION POOL - EL. 632
PERMANENT POOL ELEV. 628 - 1,130 A-F
ELEV. 619
RESERVOIR STORAGE / INFLOW
VOLUME IN ACRE-FEET
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
80
DURATION IN DAYS
THAMES RIVER BASIN
EAST BRIMFIELD LAKE
DROUGHT CONTINGENCY
STORAGE VS. FLOW DURATION
PLATE 4


800
750
700
CONSERVATION
700



WATER RESOURCES DEVELOPMENT PROJECT

EAST BRIMFIELD RESERVOIR

RESERVOIR MAP

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. FEB 1968

PLATE 5

2